

## Fuel Cell Electric Vehicles

Fuel cells have captured worldwide attention as a clean power source for electric vehicles (EVs). EVs powered by fuel cells are being developed by many auto manufacturers, and have generated interest and enthusiasm among industry, environmentalists and consumers.

### What are the benefits?

A fuel cell EV, powered by an electric motor, promises the air quality benefits of a battery-powered EV, combined with the driving range and convenience of a conventional gasoline engine. Compared to conventional vehicles, fuel cell EVs can offer:

- zero or near-zero smog-forming emissions,
- reduced water pollution from oil leaks,
- lower greenhouse gas emissions (CO<sub>2</sub>),
- higher fuel economy,
- greater engine efficiency and
- much quieter and smoother operation.

If alternative fuels are used as a source for hydrogen, fuel cell EVs will also encourage greater energy diversity.

A fuel cell using pure hydrogen produces no pollution. However, the production of hydrogen gas for use in fuel cells is expected to result in extremely low air pollution emissions.

### What is a fuel cell?

In principle, a fuel cell operates like a battery. A fuel cell converts chemical energy directly into electricity by combining oxygen from the air with hydrogen gas. However, unlike a battery, a fuel cell does not run down or require recharging. It will produce electricity as long as fuel, in the form of hydrogen, is supplied.

Fuel cells have been a reliable power source for many years. Applications include electrical power supply for space flights as well as conventional electric power generation in buildings and power plants.

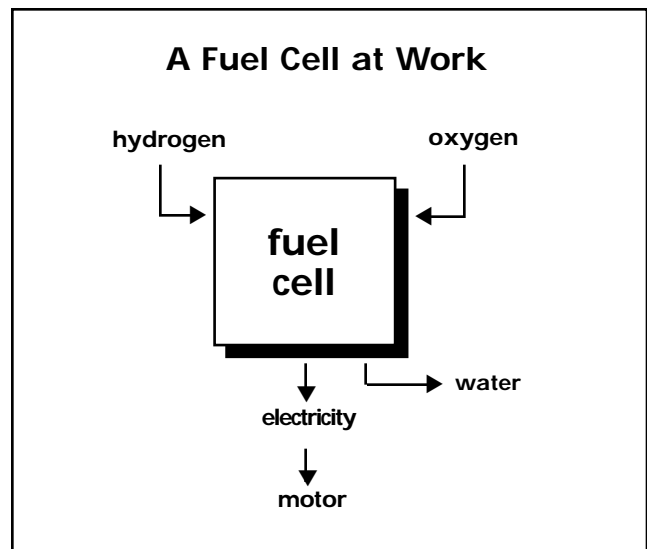
### How Does A Fuel Cell Work?

An individual fuel cell consists of two electrodes, one positively charged (cathode) and one negatively charged (anode), with a substance that conducts electricity (electrolyte) sandwiched between them.

Oxygen from the air passes over the cathode and hydrogen over the anode, generating electricity and water.

The hydrogen fuel for a fuel cell EV can be supplied in several ways. Some vehicles carry a tank of pure hydrogen. Others could be equipped with a "fuel reformer" that converts hydrocarbon fuels—such as methanol, natural gas, or gasoline—into a hydrogen-rich gas.

Individual fuel cells must be combined into groups called fuel cell stacks in order to achieve the necessary power required for motor vehicle applications.



Fuel cells convert hydrogen and oxygen (from the air) into electricity and water.

### **What is the current status of fuel cell electric vehicles?**

Impressive advances in fuel cell technology have been made over the last several years. Auto manufacturers such as DaimlerChrysler, Ford, Toyota and General Motors have announced plans to have fuel cell EVs commercially available by 2004. Prototype passenger vehicles are now being tested. Transit buses powered by fuel cells are currently carrying passengers in public demonstration programs in several North American cities.

### **What is ARB doing to support fuel cell electric vehicles?**

Fuel cells are a very promising technology for use in both light-duty and heavy-duty vehicles. ARB is working closely with public and private partners on research and development, vehicle demonstration programs, and the infrastructure and safety requirements needed to support these vehicles.

In 1996, ARB established the Fuel Cell Technical Advisory Panel (Panel). The Panel independently assessed developing fuel cell technology and the prospects for fuel cell EVs within the next five to ten years. It concluded that fuel cell stacks now meet all of the key requirements for automotive propulsion. Technical challenges that remain include the integration of fuel cell stacks, fuel processors and auxiliary components into commercial EVs that meet consumer demands for performance and cost. All major auto manufacturers are making significant progress toward integrating these components and reducing their cost.

### **California Fuel Cell Partnership**

ARB is a founding member of the California Fuel Cell Partnership, a collaboration of auto manufacturers (DaimlerChrysler and Ford), fuel providers (Arco, Shell and Texaco), a fuel cell developer (Ballard), and government agencies (ARB and the California Energy Commission). The Partnership will bring fuel cell electric vehicles to California beginning in 2000, and seeks to demonstrate the potential of this new technology as a safe, practical, clean and efficient alternative to conventional vehicles.

### **For More Information**

For more information, please contact the ARB toll-free at (800) END-SMOG/(800) 363-7664 (California only) or (800) 242-4450. You will also find information on fuel cells at ARB's web site— <http://www.arb.ca.gov> or at the California Fuel Cell Partnership web site at <http://www.drivingthefuture.org>.

You may obtain this document in an **alternative format** by contacting the ARB's ADA Coordinator at (916) 322-4505 (voice), (916) 324-9531 (TDD, Sacramento area), or (800) 700-8326 (TDD, outside Sacramento).